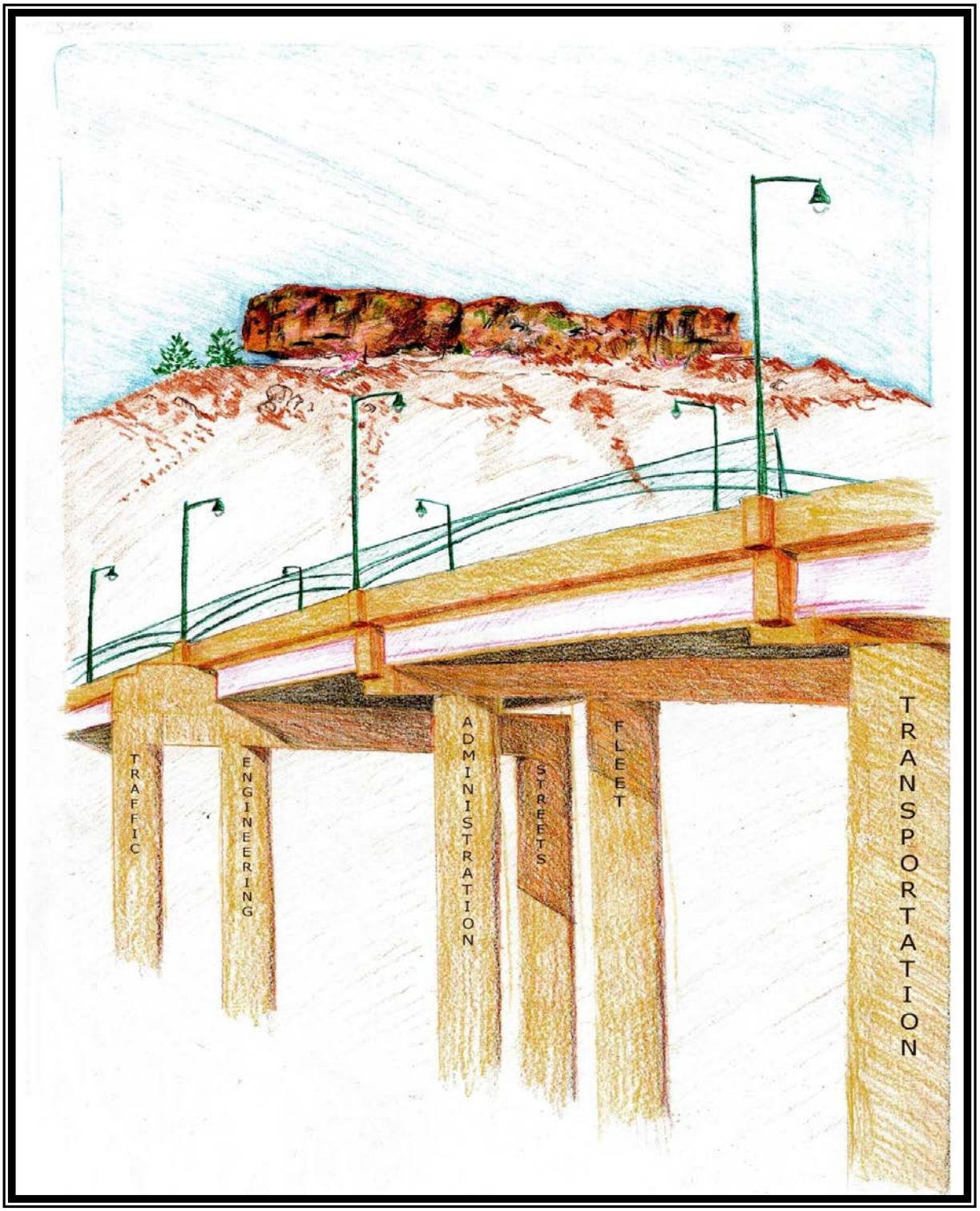
ATTACHMENT A

2014 TOWN OF CASTLE ROCK
MOTOR VEHICLE CRASH FACTS



PREPARED BY THE PUBLIC WORKS DEPARTMENT

ACKNOWLEDGEMENTS

This report was assembled from data provided by the Castle Rock Police Department crash report data from the year 2014. Each crash record, whether completed by a local police officer or a member of the Colorado State Patrol, was sent to Castle Rock and entered into a centralized database maintained by the Public Works Department.

The report itself was created by personnel in the Public Works Department.

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TOWN OF CASTLE ROCK COLORADO

Public Works Department

"Our mission is to provide outstanding service, safety and support for transportation infrastructure and maintenance."

September 1, 2015

It is our pleasure to provide you with the 11th Annual Castle Rock Motor Vehicle Crash Facts Report. The statistics provided will enable emergency services and design engineers alike gain a greater insight into the factors contributing to traffic crashes. This will then help both the Town and the Colorado Department of Transportation identify improvements that may help reduce crashes in a high-hazard areas or intersections.

We will continue to dedicate our time and efforts toward the improvement of safety on our street system.

Sincerely,

Robert Goebel, PE
Public Works Director

Ryan Germeroth, PE
Transportation Planning and Traffic Engineering Manager

EXECUTIVE SUMMARY

The mission of the Public Works Department is “To provide outstanding service, safety and support for transportation infrastructure and maintenance”. We believe that by analyzing our crash data on a regular basis we can help identify locations where the roadway environment may be a contributing factor to crashes. This information helps us to develop options for improvements and to schedule projects for correction. Since 2004, when Public Works first reported crash statistics, the numbers of fatalities, and persons injured have generally been declining. The Town’s focus on encouraging intersection treatments such as the use of roundabouts, which have demonstrated an ability to reduce personal injury type accidents such as high speed “T-bone” crashes, are just one example of improvements that have assisted in this area. We also saw an increase in the number of crashes when compared to 2013 but this is not unexpected as traffic volumes in the Town have increased as well.

Crashes are the result of many factors. These factors can generally be classified into three main categories: 1) human factors, 2) vehicle factors, and 3) roadway environment. By far, the largest percentage of crashes can be attributed to human factors. These are the factors that drivers can control and are usually the simplest to correct. Basic driver awareness and respect for all users of the Town’s roadways will go the farthest towards reducing the number of crashes. Education, Enforcement and Engineering, the three “E’s”, all play an important role in improving safety. However it will take conscious decisions by drivers to change their behavior in order to make our roadway system safer.

Addressing vehicle factors is the responsibility of everyone who owns and operates a motor vehicle. Regular vehicle inspections along with preventative maintenance procedures will help reduce the chances of a crash occurring as a result of a vehicle malfunction.

The roadway environment is something that is out of the driver’s control, but it is within the control of the Town, and the Colorado Department of Transportation (CDOT) in the case of the State system. We work to identify locations where roadways themselves could be a contributing factor in a crash and implement treatments to correct these. Public Works uses statistical modeling to identify the locations where corrections to the roadway environment may improve safety. This helps direct limited resources to the locations where the most benefit can be obtained and avoids directing these resources toward locations where problems may not exist.

The information and crash trends that become evident during the preparation of the annual crash report help staff identify needed intersection improvements. For example, in order to help reduce the number of crashes involving left turning vehicles, the left turn signal operations have been changed in the past at locations with a higher than expected total of crashes. Similar changes have been made recently with the installations of flashing yellow arrows at Founders at Front and Blackfeather at Front.

The 2014 data does show a few locations with higher numbers of crashes than could be expected to occur at intersections having similar characteristics. Several projects have been identified that have either already been completed or will be completed that are expected to help to reduce the number of collisions at the highest crash locations. All of the information gathered by staff will be forwarded along to CDOT for their use at intersections along the State Highway system in Castle Rock.

SECTION 1: 2014 Raw Data Summaries

This section summarizes the raw crash data for 2014 by various categories. The totals include all forms of transportation and include pedestrian, bicycle and motorcycle crashes. The purpose of this is for general public interest as well as for use by other staff departments that may use this information to assist with improving their operations.

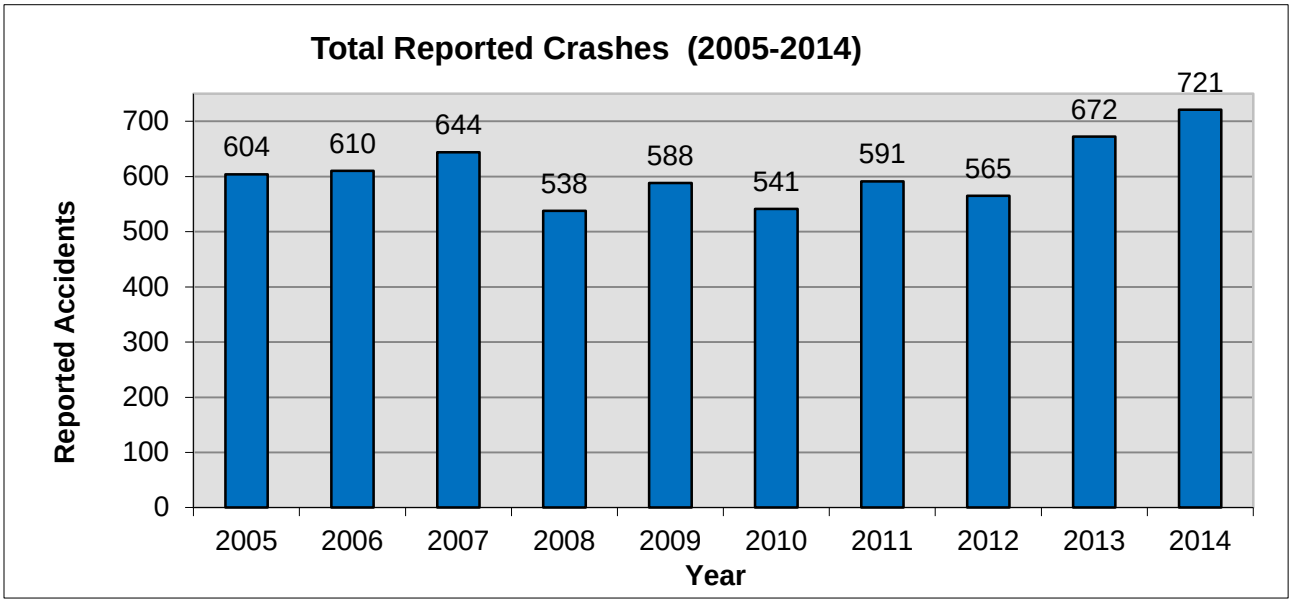
QUICK FACTS

	2014	2013	2012
Fatalities	1	1	0
Persons Injured	47	54	46
Injury Incident Crashes	38	47	45
Total Reported Crashes	721	672	565

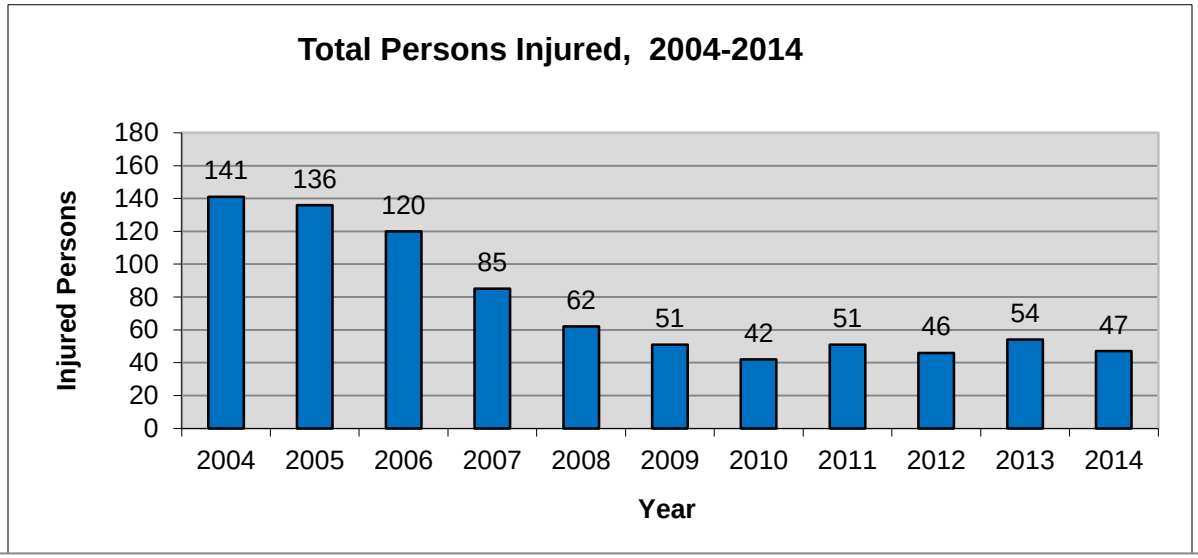
- On average, one traffic crash was reported every 12 hours.
- Of all the crashes, the most frequent crash types were rear end collisions at 40% of the total, 22% were front to side collisions and 14% were collisions with fixed objects.
- Of all crashes 20% occurred at night.

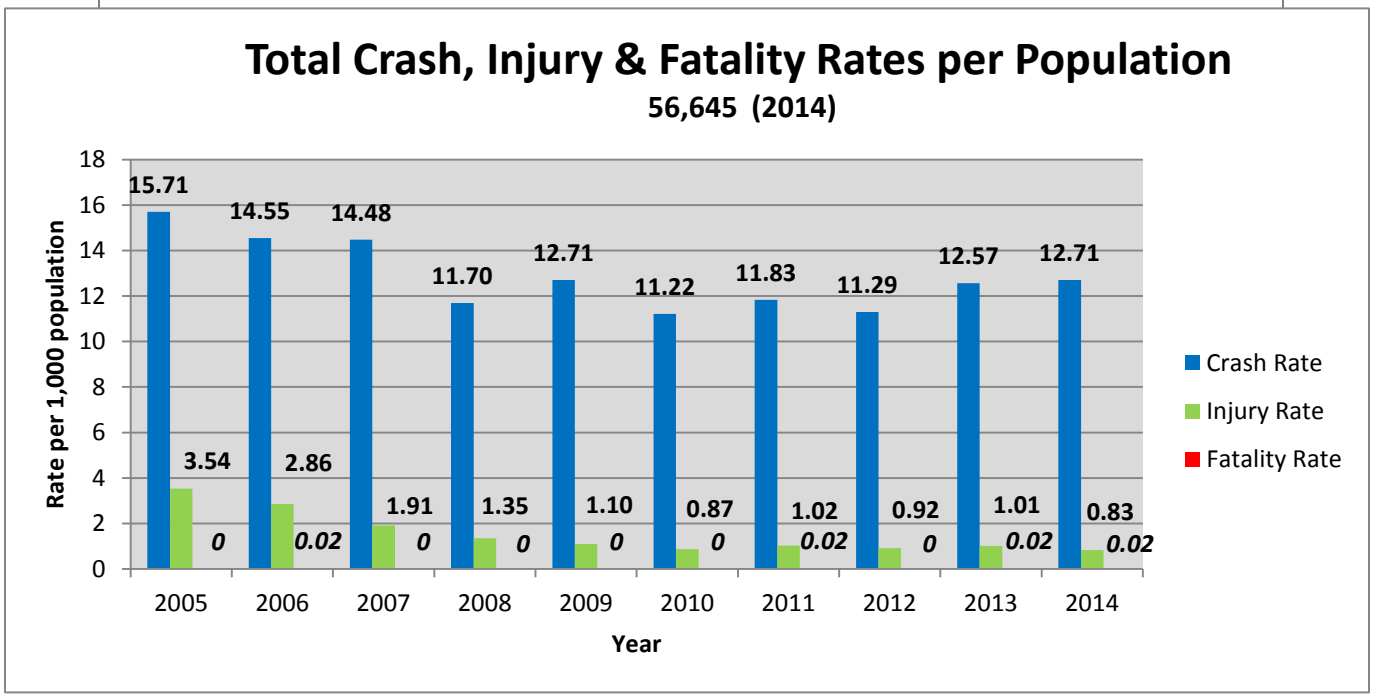
ANNUAL TRENDS

Over the past ten years the Town has averaged 607 reported crashes per year. In 2014 the number of crashes was 7% higher than in 2013, and 19% over the previous ten year average. The following charts provide a summary of the annual trends in recent years.

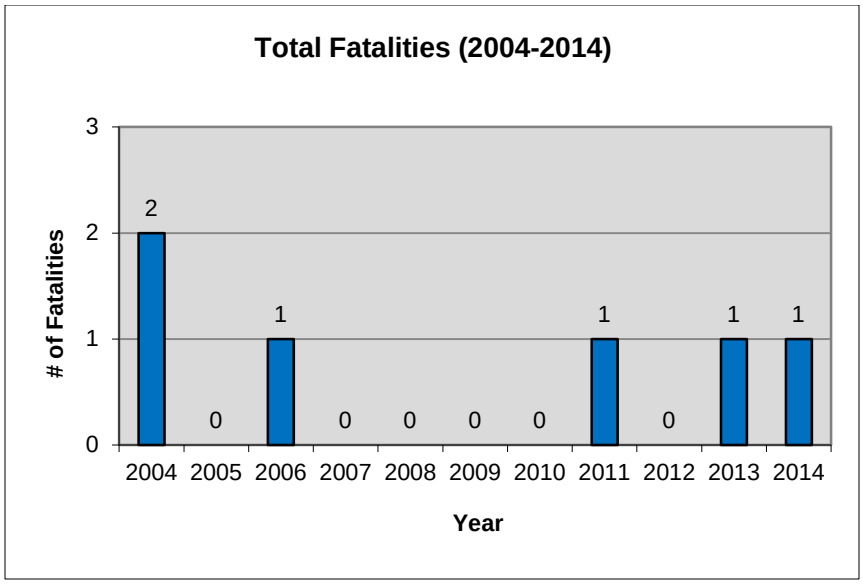


The number of people injured in 2014 crashes decreased by 13% from 2013's total of people injured. (*the method of reporting injured persons changed statewide in July 2007)

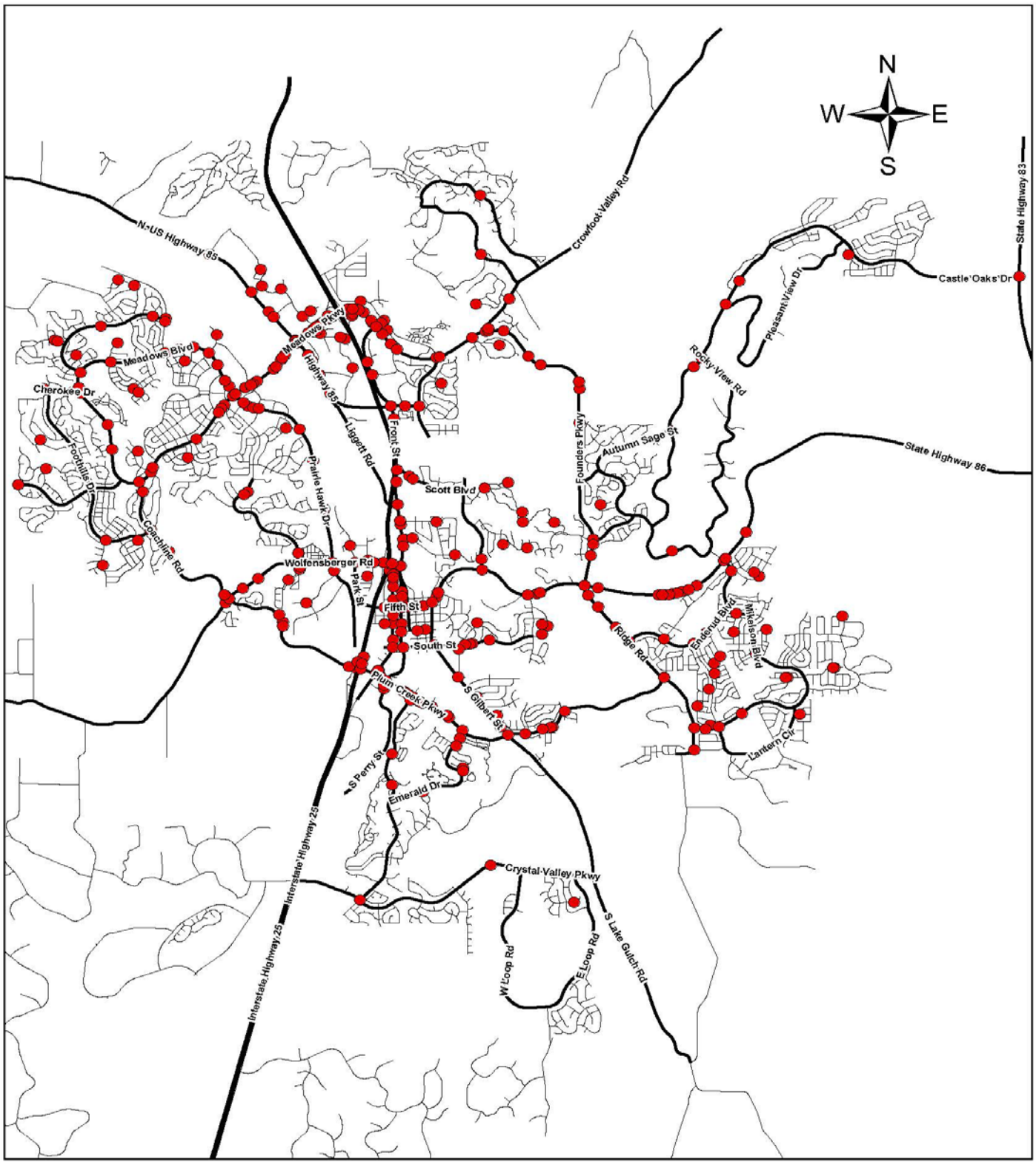




There was one fatality recorded last year. This crash involved a truck and an SUV on Meadows Blvd west of Low Meadow Blvd. This crash occurred prior to the widening and median construction project on Meadows Blvd. The driver of the SUV lost control of his vehicle on the snow covered road going eastbound and crossed into the westbound lane. The SUV struck the truck front to front resulting in the death of the SUV driver from injuries sustained due to not wearing a seatbelt.


Total Fatalities (2004-2014)
# of Fatalities
3
2
1
0
2
0
1
0
0
0
0
1
0
1
1
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year

Accident Pin Map 2014



This map shows the crash locations throughout the town. Many of these locations had several crashes reported. The arterial and collector streets have the highest incident of crashes, which is expected considering that they also have the highest traffic volumes. When reviewing new developments, we limit the number of new access points on these classifications of streets. By doing this, the potential for crashes decreases.

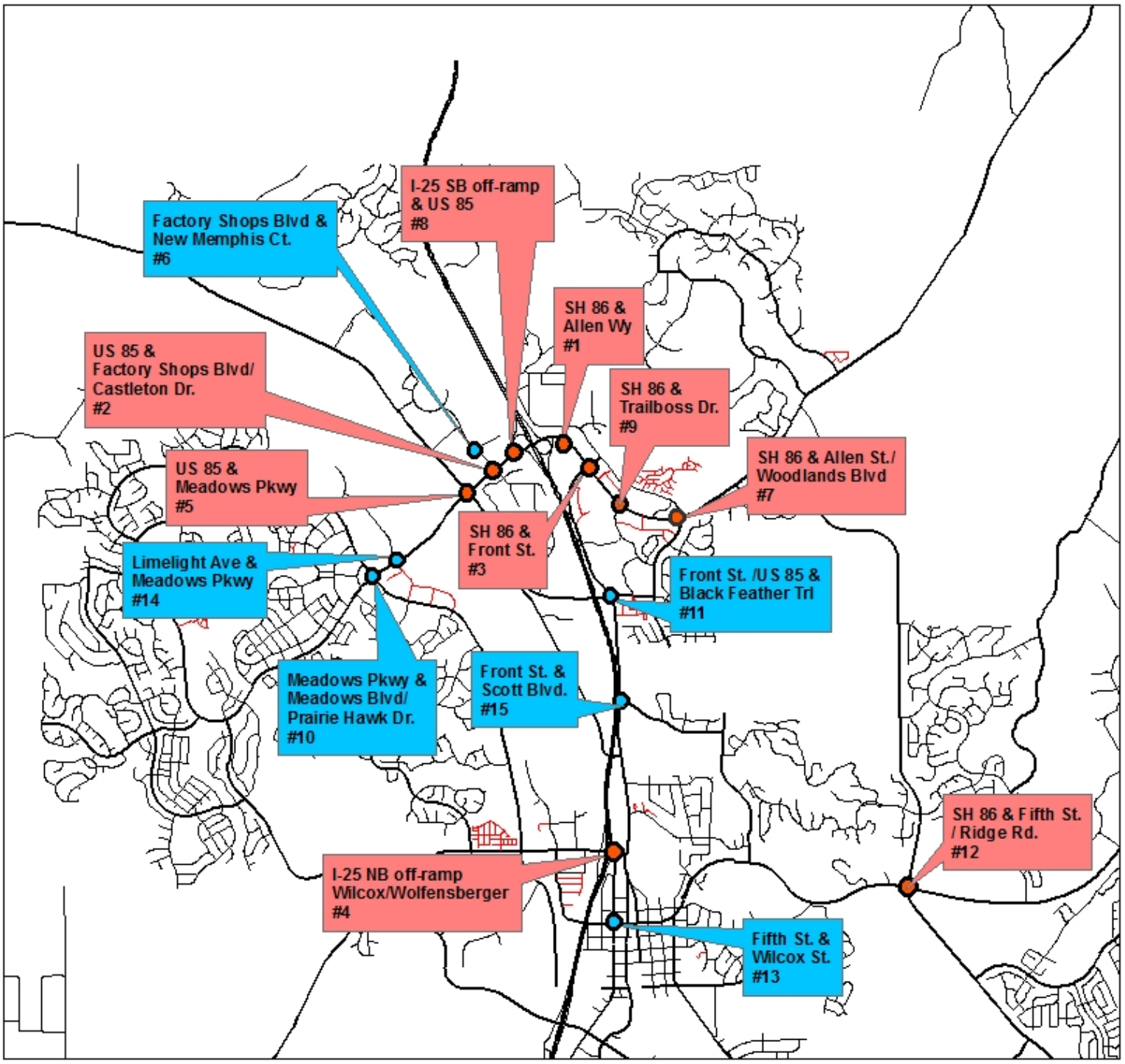
HIGHEST CRASH RATES BY LOCATION

At Intersections*

Intersections	Number of Crashes (2012 – 2014)	Avg. Volume through intersection	Crash Rate / (MEV)	Rank (2014)/(2013)
SH 86 @ Allen Way	103	49,898	1.89	1/2
US 85 @ Factory Shops / Castleton Dr.	113	62,177	1.66	2/3
SH 86 @ Front St.	65	43,932	1.37	3/1
NB I-25 @ Wilcox St.	33	22,657	1.33	4/9
US 85 @ Meadows Pkwy	59	41,181	1.31	5/6
Factory Shops Blvd @ New Memphis	21	16,020	1.20	6/-
SH 86 @ Allen St./ Woodlands Blvd.	31	27,785	1.02	7/5
SB I-25 @ US 85	62	60,063	0.87	8/13
SH 86 @ Trail Boss Dr.	29	31,082	0.85	9/10
Meadows Pkwy @ Meadows Blvd/ Prairie Hawk Dr.	34	36,575	0.85	10/11
Front St. @ Black Feather / Hwy 85	21	22,620	0.85	11/-
SH 86 @ Fifth / Ridge	29	31,023	0.83	12/-
Fifth @ Wilcox St.	20	22,408	0.82	13/4
Meadows Pkwy @ Limelight Ave	29	36,221	0.73	14/7
Front St. @ Scott Blvd	17	22,195	0.70	15/-

***Crashes within 100 ft. of the intersection**

15 Highest Accident Rate Locations



CDOT Controlled Intersections

Town Controlled Intersections

N
W E
S

SECTION 2: Public Works Statistical Analysis

This section of the report summarizes the statistical review of the 2014 raw data. The purpose of this is to provide an initial "screen" to identify the signalized intersections that are producing crash numbers that exceed the number that may be expected to occur when compared to similar intersections sharing similar characteristics in Colorado. The reason signalized intersections are the primary focus is related to the ability to produce an accurate statistical model. As more data becomes available, the Town will work toward establishing models for all intersection types: roundabouts, four-way stops, two-way stops, and non-intersection segments. Since crashes are "expected" to occur, it's important to determine which locations are experiencing crashes at a higher rate than should be expected.

ROAD & INTERSECTION SAFETY

One important goal from this crash data is to identify locations where the road environment may be a contributing factor to crashes. This is possible through statistical analysis. The goal in this regard is to identify locations where roadways or traffic control devices could be a contributing factor and implement treatments to correct these.

The definition of the safety of a road section or intersection used by the Transportation Planning and Traffic Engineering Division is the number of crashes expected to occur at these locations during a specified period as compared to what actually has occurred. Because there are factors that are not related to the physical roadway environment that contribute to crashes, road sections and intersections are expected to have crashes occur. Since what is 'expected' cannot be known, safety can only be estimated, and estimation is in degrees of precision. The precision of an estimate is usually expressed by its standard deviation.

For practical reasons Traffic Engineering is interested in the safety of a road section or intersection that seems to have too many crashes. If the estimation of safety is based only on crash counts or crash rates, the estimate would be biased. The existence of this 'regression-to-mean' bias has been long recognized given that crash rates at a given location tend to fluctuate from one year to the next due to multiple variables. If not accounted for, regression-to-mean bias is known to produce inflated estimates of countermeasure effectiveness so it is important to review several years' worth of data to account for statistical anomalies.

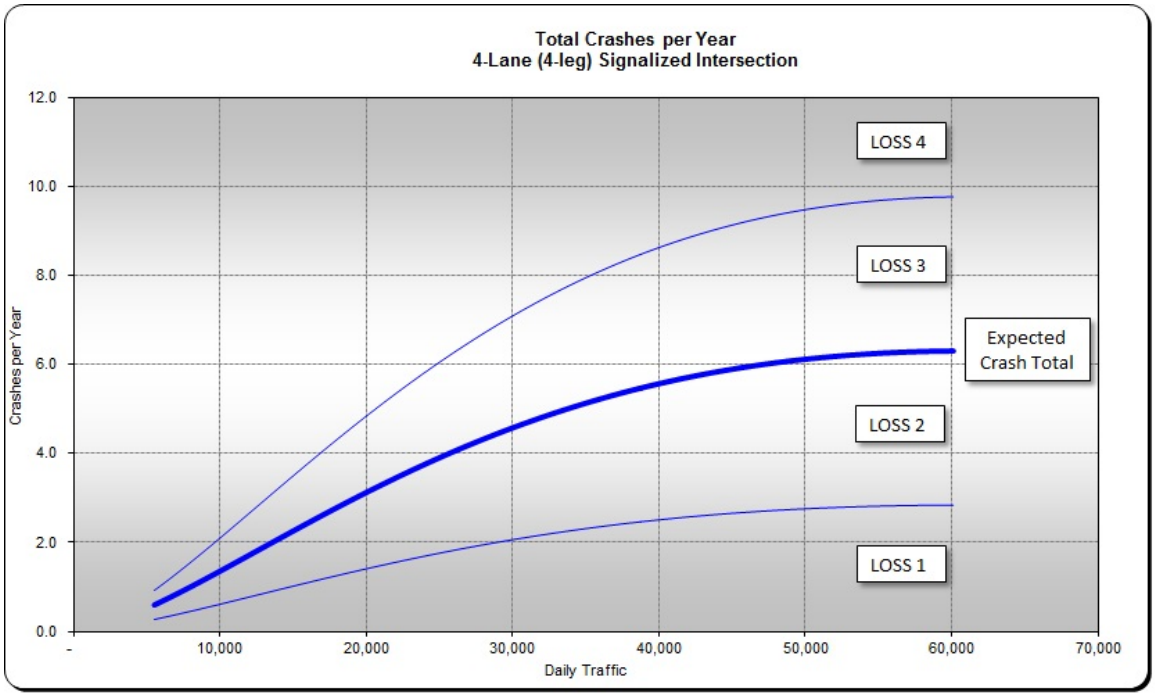
In light of this, the magnitude of safety problems at intersections can be assessed through the use of Safety Performance Functions (SPF). The SPF reflects the complex relationship between exposure (measured in daily traffic) and the crash count for an intersection measured in crashes per year. The SPF models provide an estimate of the normal or expected crash frequency and severity for a range of ADT among similar facilities. The Colorado Department of Transportation (CDOT) has calibrated several different Safety Performance Functions based on actual crash data collected at intersections throughout the State.

All of the dataset preparation was performed using the Town's crash databases. Crash history for each intersection was prepared using the most recent three years of available crash data. Average Daily Traffic (ADT) for each intersection approach (major street and minor street) over the three years was entered into the same dataset.

Development of the SPF lends itself well to the conceptual formulation of the Levels of Service of Safety (LOSS). The concept of level of service uses quantitative measures that characterize safety of an intersection in reference to its expected performance. If the level of safety predicted by the SPF will represent a normal or expected number of crashes at a specific level of ADT, then the degree of deviation from the norm can be stratified to represent specific levels of safety.

LOSS-I – Indicates low potential for crash reduction
LOSS-II – Indicates better than expected safety performance
LOSS-III – Indicates less than expected safety performance
LOSS-IV – Indicates high potential for crash reduction

Gradual change in the degree of deviation of the LOSS boundary line from the fitted model mean reflects the observed increase of variability in crashes as ADT increases. LOSS reflects how the intersection is performing in regard to its expected crash frequency at a specific level of ADT (major street and minor street). It only provides a crash frequency comparison with the expected norm. It does not, however, provide any information related to the nature of the safety problem itself. If a safety problem is present, LOSS will only describe its magnitude from the frequency standpoint. The nature of the problem is determined through diagnostic analysis using direct diagnostics and pattern recognition techniques and will be discussed later in this report. The following provides an example of a SPF for a 4-lane signalized intersection as well as the corresponding LOSS categories.



SIGNALIZED INTERSECTIONS WITH THE HIGHEST CRASH RATES

The following tables summarize the 2014 highest crash rate locations. This table provides the actual crash total, the statistically expected crash total as well as the Level of Service of Safety and corresponding safety performance.

Intersections	Expected Crash History (Crashes / Year)	Observed Crash History (Crashes / Year)	Level of Service of Safety	Safety Performance
SH 86 @ Allen Way	18.6	34.3	4	High potential for crash reduction
US 85 @ Factory Shops / Castleton Dr.	24.4	37.7	4	High potential for crash reduction
SH 86 @ Front St.	15.1	21.7	4	High potential for crash reduction
NB I-25 @ Wilcox St.	4.3	11.0	4	High potential for crash reduction
US 85 @ Meadows Pkwy	15.5	19.7	3	Worse than expected
Factory Shops Blvd @ New Memphis	3.1	7.0	4	High potential for crash reduction
SH 86 @ Allen St./ Woodlands Blvd.	7.5	10.3	3	Worse than expected
SB I-25 @ US 85	26.4	20.7	2	Better than expected
SH 86 @ Trail Boss Dr.	9.6	9.7	2/3	Average performance
Meadows Pkwy @ Meadows Blvd/ Prairie Hawk Dr.	13.2	11.3	2	Better than expected
Front St. @ Black Feather / Hwy 85	6.2	7.0	3	Worse than expected
SH 86 @ Fifth / Ridge	10.3	9.7	2	Better than expected
Fifth @ Wilcox St.	5.2	6.7	3	Worse than expected
Meadows Pkwy @ Limelight Ave	9.6	9.7	2/3	Average performance
Front St. @ Scott Blvd	5.4	5.7	2/3	Average performance

As can be seen in this table there are a total of nine intersections that have an observed crash total that is higher than what would be expected at other similar intersections in Colorado. The next section provides a summary of the crash types to focus on potential areas for improvement to the roadway environment.

PLANNED MITIGATION MEASURES

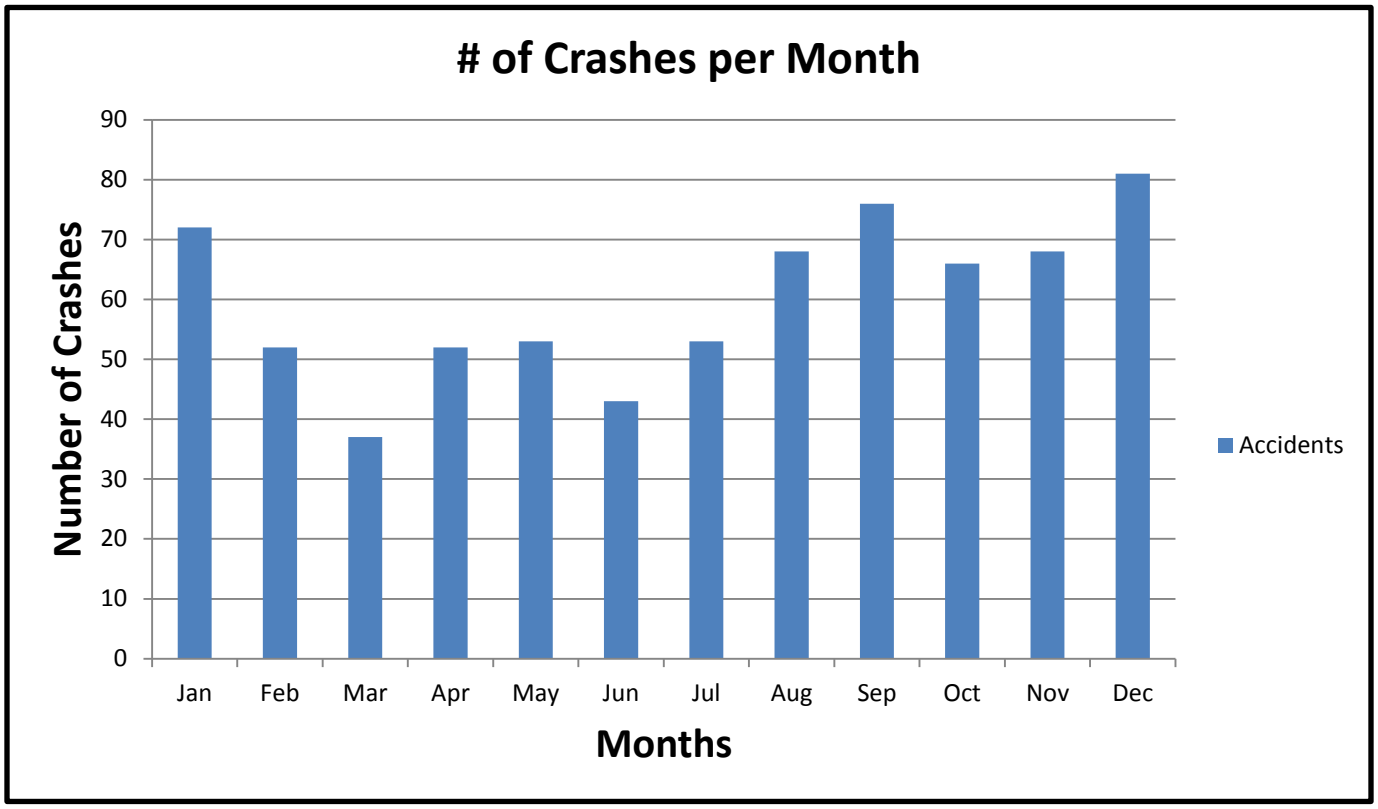
The crash history from January 2012 to December 2014 was reviewed for each of the nine intersections with a LOSS rating of 3 or higher. The following tables summarize the crash type(s) at each intersection that was higher than would be expected for a similar four or six lane signalized intersection in Colorado.

Intersections	Crash Type(s) in Need of Correction	Mitigation Measures
SH 86 @ Allen Way	Rear end, Approach Turn (left turns & opposing thrus)	Review the red / yellow clearance intervals as part of 2016 Meadows / Founders signal timing project. Review potential changes to existing left turn phasing.
US 85 @ Factory Shops / Castleton Dr.	Rear end	Review the red / yellow clearance intervals as part of 2016 Meadows / Founders signal timing project.
SH 86 @ Front St.	Rear end, Approach Turn (NB lefts & SB thrus)	Review the red / yellow clearance intervals as part of 2016 Meadows / Founders signal timing project. Flashing yellow arrow was installed for north / south lefts in 2014.
NB I-25 @ Wilcox St.	Approach Turn (EB lefts & WB thrus)	Review potential changes to eastbound left turn phasing. A longer term solution could be to replace the existing traffic signal with a roundabout.
US 85 @ Meadows Pkwy	Rear end	Review the red / yellow clearance intervals as part of 2016 Meadows / Founders signal timing project.
Factory Shops Blvd @ New Memphis	Broadside (WB thrus & SB thrus)	Review signal timing for WB approach. A roundabout has been considered at this intersection as an option in the past but will need to be reevaluated due to the change in traffic conditions.
SH 86 @ Allen St./ Woodlands Blvd.	Rear end	Review the red / yellow clearance intervals as part of 2016 Meadows / Founders signal timing project.
Front St. @ Black Feather / Hwy 85	Approach Turn (NB lefts & SB thrus)	Flashing yellow arrow was installed on all approaches in early 2015
Fifth @ Wilcox St.	Rear end	Red / yellow clearance intervals reviewed and modified as part of 2015 5th St. signal retiming

As can be seen in this table, primarily rear end collisions and approach turn collisions (a crash where a left turning vehicle turns out in front of an opposing through vehicle) are the crash types that are occurring at a rate that is more frequent than expected. By nature, traffic signals tend to cause an increase in rear end collisions so they cannot be eliminated entirely. However, certain measures such as improved signal timing can help to reduce the number of rear end collisions by reducing congestion. Town staff will work to implement the other measures not yet complete in the table above over the remainder of 2015 and early 2016.

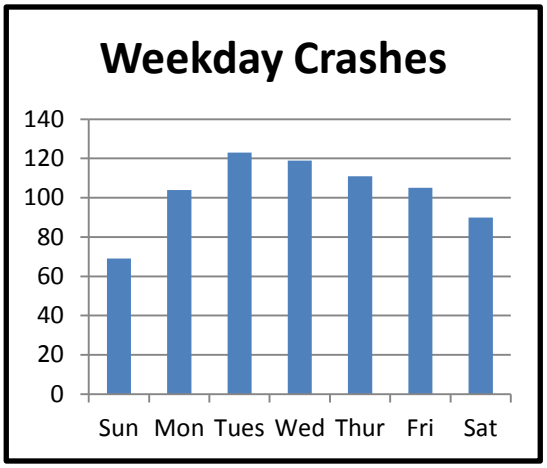
2014 CRASH DATA TRENDS & METRICS

Months	Crashes	%	Fatalities	%
January	72	11%	1	100%
February	52	7%	0	0%
March	37	5%	0	0%
April	52	7%	0	0%
May	53	7%	0	0%
June	43	6%	0	0%
July	53	7%	0	0%
August	68	9%	0	0%
September	76	12%	0	0%
October	66	9%	0	0%
November	68	9%	0	0%
December	81	11%	0	0%
Total	**721**	**100%**	**1**	**100%**

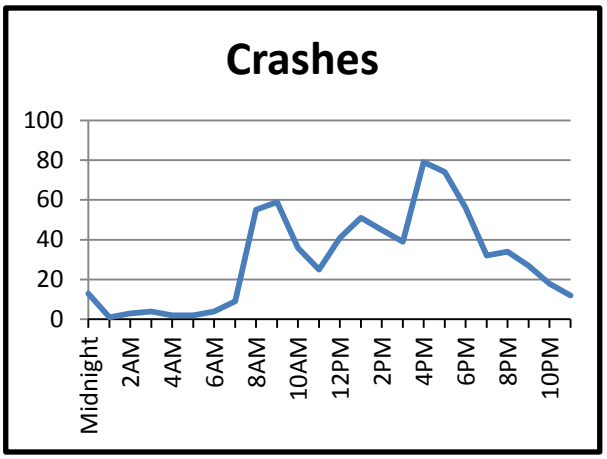


Crash Breakdown by Weekday and Time in 2014

	Crashes	%	Fatalities	%
Sunday	69	10%	-	0%
Monday	104	14%	-	0%
Tuesday	123	17%	-	0%
Wednesday	119	17%	-	0%
Thursday	111	15%	1	100%
Friday	105	14%	-	0%
Saturday	90	13%	-	0%
Total	**721**	**100%**	**1**	**100%**



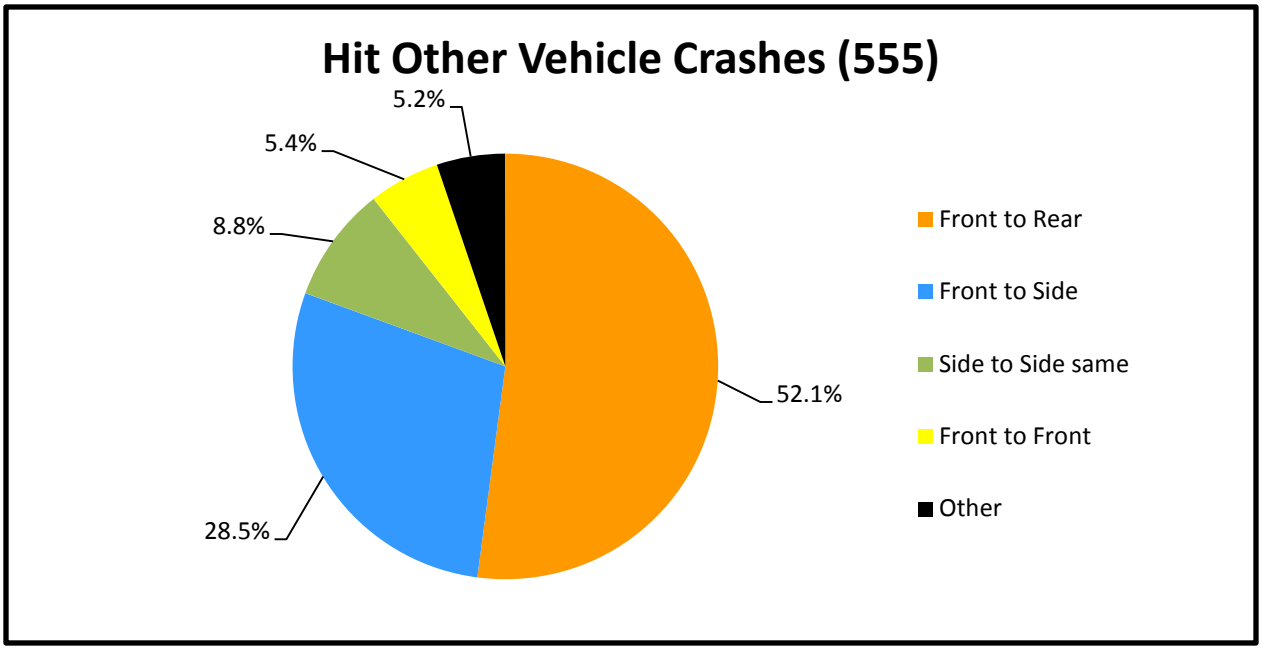
	Crashes	%	Fatalities	%
12:00am	13	2%	-	0%
1:00am	1	0%	-	0%
2:00am	3	0%	-	0%
3:00am	4	1%	-	0%
4:00am	2	0%	-	0%
5:00am	2	0%	-	0%
6:00am	4	1%	-	0%
7:00am	9	1%	-	0%
8:00am	55	8%	-	0%
9:00am	59	8%	-	0%
10:00am	36	5%	-	0%
11:00am	25	3%	-	0%
12:00pm	41	6%	-	0%
1:00pm	51	7%	-	0%
2:00pm	45	6%	-	0%
3:00pm	39	5%	-	0%
4:00pm	79	11%	-	0%
5:00pm	74	10%	-	0%
6:00pm	56	8%	-	0%
7:00pm	32	4%	-	0%
8:00pm	34	5%	-	0%
9:00pm	27	4%	1	100%
10:00pm	18	3%	-	0%
11:00pm	12	2%	-	0%
Total	**721**	**100%**	**1**	**100%**



TYPES OF CRASHES

Most Harmful

	Number of Fatalities	Number of Injuries	Number of Crashes	% of Crashes
Front/Front	1	3	30	4%
Front/Rear	-	10	289	40%
Front/Side	-	10	158	22%
Rear/Side	-	0	14	2%
Rear/Rear	-	0	4	1%
Side/Side opp.	-	1	11	2%
Side/Side same	-	1	49	7%
Hit Fixed or Other Object	-	11	102	14%
Rollover	-	2	9	1%
Hit Animal	-	0	23	3%
Hit Pedestrian	-	3	5	1%
Hit Bicyclist	-	3	7	1%
Hit Railway Train	-	0	0	0%
Hit Parked Vehicle	-	0	10	1%
All Others	-	3	10	1%
Total	**1**	**47**	**721**	**100%**



Vehicle Type	Vehicles Involved in Crashes	% of Vehicles
Auto	496	46%
SUV	335	32%
Pick-up	187	18%
Truck (over 10,000 lbs.)	18	2%
Motorcycle/Moped	8	1%
Bicycle	2	0%
Other	13	1%
Total	**1059**	**100%**

CRASH LOCATION

Intersections By Classification	Number of Crashes	Number of Fatalities	Number of Injuries
Arterial/Arterial	209	-	7
Arterial/Collector	147	-	12
Arterial/Local	62	-	6
Collector/Collector	38	-	1
Collector/Local	21	-	2
Local/Local	25	-	1
Total	**502**	**-**	**29**

Segments	Number of Crashes	Number of Fatalities	Number of Injuries
Multi-lane Arterial or Collector	92	-	8
Two-lane Arterial or Collector	78	1	7
Local	49	-	3
Total	**219**	**1**	**18**

CRASH ENVIRONMENT

Traffic Control Device

	Crashes	%
Railroad Device	0	0%
Roundabout	9	1%
Yield Sign	33	5%
Stop Sign	94	13%
Traffic Signal	309	42%
None	285	39%
Total	**721**	**100%**

Weather

	Crashes	%
Clear	620	86%
Rain	21	3%
Snow/Sleet	77	11%
Other	3	0%
Total	**721**	**100%**

Road Conditions

	Crashes	%
Dry	571	79%
Wet	49	7%
Icy/Slushy	99	14%
Other	2	0%
Total	**721**	**100%**

Lighting Conditions

	Crashes	%
Day	579	80%
Night	142	20%
Total	**721**	**100%**

THE DRIVER

Primary Causes of Crashes

(*4 crashes occurred with both Drivers 1 & 2 were the cause of the crash)

	Incidents	%
Failed to Yield Right of Way	101	14%
Careless/Reckless Driving	280	39%
Violation of Red Signal	35	5%
Unsafe Backing	19	2%
Speeding too fast for conditions	35	5%
Following too closely	54	8%
All Other/Unknown	197	27%
Total	**721**	**100%**

Condition of Drivers

(* 1 crash was the result of both drivers having a contributing factor to the crash)

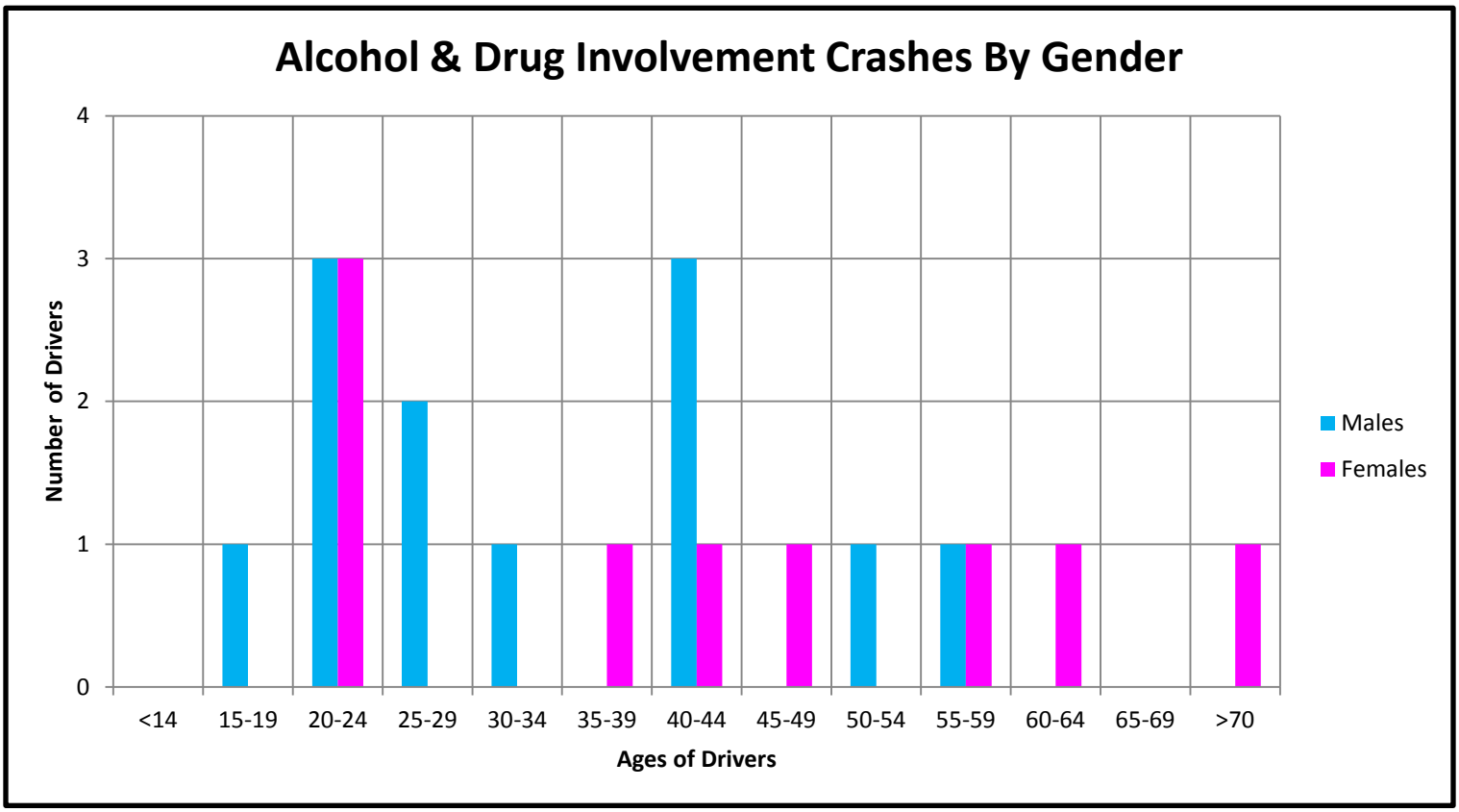
	Drivers	%
No Defect or Unknown	261	36%
Other* (includes: aggressive driving, fatigue, distractions, illness)	332	46%
Inexperienced Drivers	89	12%
Cell Phone	18	3%
Drugs or Alcohol Related	21	3%
Total	**721**	**100%**

Alcohol and Drug Involvement

* Number of Crashes Involving Drivers Influenced by Alcohol or Drugs

Age	All Drivers	Male	Female
<14	0	0	0
15-19	1	1	0
20-24	6	3	3
25-29	2	2	0
30-34	1	1	0
35-39	1	0	1
40-44	4	3	1
45-49	1	0	1
50-54	1	1	0
55-59	2	1	1
60-64	1	0	1
65-69	0	0	0
>70	1	0	1
Total	**21**	**12**	**9**

Less than 3% of the total crashes reported in 2014 involved alcohol or drugs. This was a slight decrease from 2013 and is approximately the same as the national average.

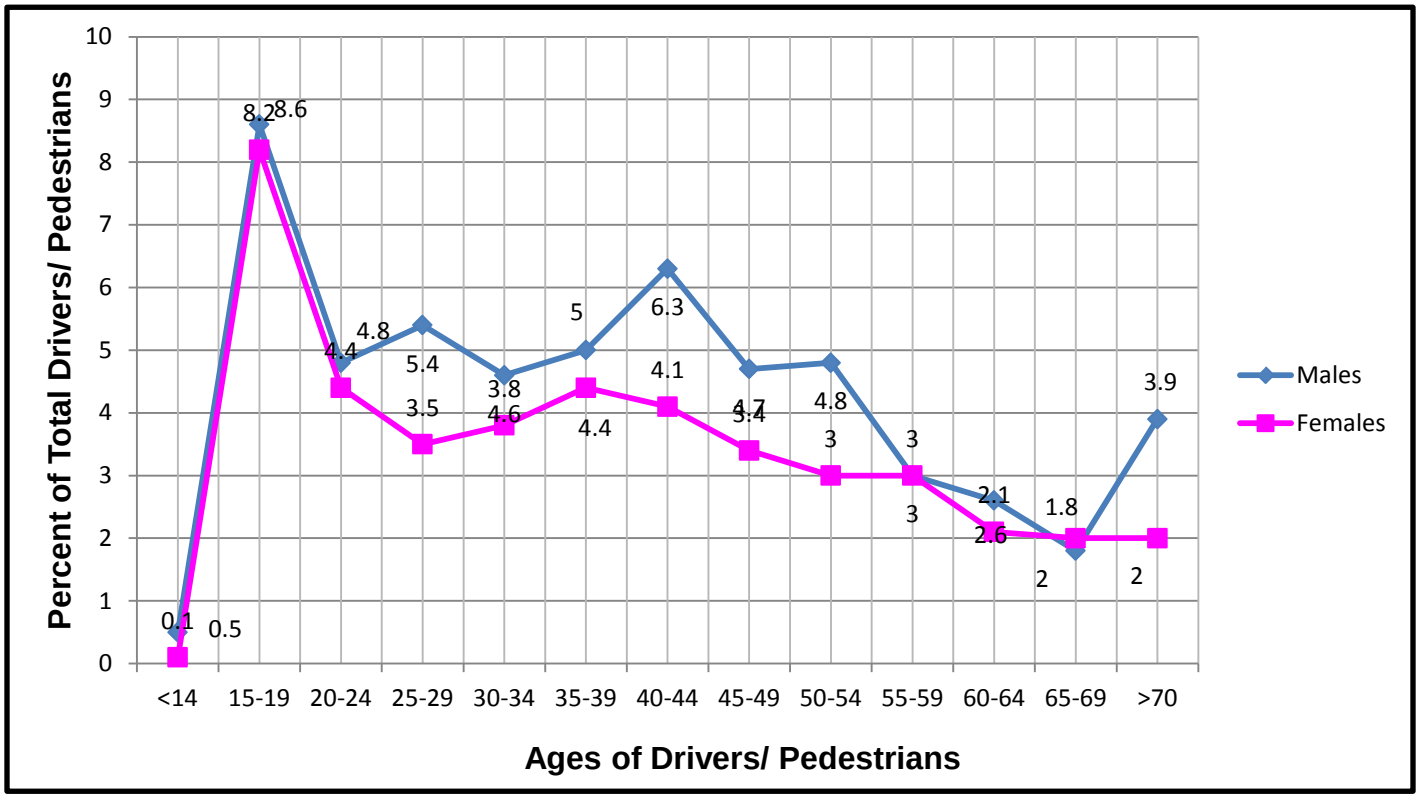


Ages of Drivers/Pedestrians Involved in Crashes Overall

*** 98 unknown drivers/pedestrians (Gender & Age)

Age	Male	Female
<14	6	1
15-19	105	100
20-24	58	54
25-29	65	42
30-34	56	46
35-39	61	53
40-44	77	51
45-49	57	42
50-54	58	36
55-59	36	37
60-64	31	26
65-69	22	24
>70	48	23
Total	**680**	**535**

Age	% of Total Drivers/Pedestrians			
	Male	Female	Total	Percent
<14	6	1	7	1%
15-19	105	100	205	17%
20-24	58	54	112	9%
25-29	65	42	107	9%
30-34	56	46	102	8%
35-39	61	53	114	9%
40-44	77	51	128	10%
45-49	57	42	99	8%
50-54	58	36	94	8%
55-59	36	37	73	6%
60-64	31	26	57	5%
65-69	22	24	46	4%
>70	48	23	71	6%
Total	**680**	**535**	**1215**	**100%**



DEFINITIONS

The following special terms are used throughout this report, and are provided to clarify the meaning of the data.

1. **Crash (or traffic crash):** An unintended event involving a motor vehicle that causes death, injury, or property damage.

2. **Alcohol Involvement Crash:** Any motor vehicle crash in which a driver, pedestrian, or bicyclist had consumed alcohol.

3. **Fatal Crash:** A traffic crash which involving the death of one or more persons.

4. **Hit-Other-Vehicle:** A type of collision in which the first harmful event involves a collision between two or more vehicles.

5. **Injury Crash:** An crash involving injuries to one or more persons which may or may not require transportation to a medical facility.

6. **Motor Vehicle:** Any motorized (mechanically or electrically powered) vehicle not operated on rails.

7. **Other Non-collision:** An event during an crash sequence which does not involve a collision with another vehicle or object.

8. **Property Damage Crash:** An crash not involving either a fatality of an injury to any party but which does include damage to one or more vehicles.

9. **Rollover:** An crash in which the overturning of a vehicle was the first harmful event.

10. **Type of Crash:** The category which best describes the general type of collision which was the first event.